

1. An ignition diagnostic system for an internal combustion engine, comprising:

- an ignition coil having a primary coil coupled to a secondary coil, said secondary coil connected across an electrode gap of an ignition plug;
- means for producing a bias voltage across said electrode gap during a period of time following generation of a spark across said gap;
- a detection circuit producing a buffered version of any ion current flowing across said electrode gap resulting from said bias voltage; and
- a diagnostic circuit responsive to said buffered version of said ion current to produce an output signal, said output signal defining a pulse width indicative of combustion quality that is proportional to an amount of said ion current flowing across said electrode gap.

15 2. The system of claim 1 wherein said diagnostic circuit is configured to produce said output signal with a pulse width indicative of complete combustion if said ion current flowing across said electrode gap is greater than a first predefined amount of current.

20 3. The system of claim 1 wherein said diagnostic circuit is configured to produce said output signal with a pulse with indicative of a non-combustion event if said non current flowing across said electrode gap is less than a second predefined amount of current.

25 4. The system of claim 1 further including a capacitor electrically connected to said diagnostic circuit, said diagnostic circuit charging said capacitor proportional to an amount of ion current flowing across said electrode gap, said pulse width of said output signal defined by a discharge time of said capacitor to a predefined voltage level.

5. The system of claim 1 further including an ignition control circuit configured to control a coil switching device electrically connected to said primary coil, said ignition control circuit configured to control said coil switching device to energize said primary coil a plurality of times during any ignition plug firing event.

6. The system of claim 5 wherein said means for producing a bias voltage includes said coil switching device, said primary coil and said secondary coil, said bias voltage resulting from a rapid increase in a voltage across said primary coil each of said plurality of times said coil switching device energizes said primary coil.

7. The system of claim 5 wherein said diagnostic circuit is configured to produce said output signal with a pulse width indicative of complete combustion if said ion current flowing across said electrode gap is greater than a first predefined amount of current;

said diagnostic circuit further configured to produce a termination signal indicative of an end of said ignition plug firing event if said ion current flowing across said electrode gap is greater than said first predefined amount of current.

8. The system of claim 1 further including an ignition control circuit configured to control a coil switching device electrically connected to said primary coil, said ignition control circuit configured to control said coil switching device to energize said primary coil only a single time during any ignition plug firing event.

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9. The system of claim 1 further including a control circuit responsive to said output signal to determine a quality of combustion of an air/fuel mixture within an engine cylinder in communication with said ignition plug.

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10. The system of claim 9 wherein said control circuit is responsive to a number of output signals each corresponding to a different one of a corresponding number of engine cylinders to determine a quality of combustion of an air/fuel mixture within any of said number of engine cylinders.

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11. An ignition diagnostic system for an internal combustion engine, comprising:

an ignition coil having a primary coil coupled to a secondary coil, said secondary coil connected across an electrode gap of an ignition plug;

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means for producing a bias voltage across said electrode gap during a period of time prior to generation of a spark across said gap;

a detection circuit producing a buffered version of any ion current flowing across said electrode gap resulting from said bias voltage; and

a diagnostic circuit responsive to at least some amount of said buffered version of said ion current to produce an output signal defining a pulse width indicative of a fouled plug condition.

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12. The system of claim 11 further including a capacitor electrically connected to said diagnostic circuit, said diagnostic circuit charging said capacitor proportional to an amount of ion current flowing across said electrode gap, said pulse width of said output signal defined by a discharge time of said capacitor to a predefined voltage level.

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13. The system of claim 11 further including an ignition control circuit configured to control a coil switching device electrically connected to said primary coil, said ignition control circuit configured to control said coil switching device to energize said primary coil a plurality of times during any ignition plug
5 firing event.

14. The system of claim 13 wherein said means for producing a bias voltage includes said coil switching device, said primary coil and said secondary coil, said bias voltage resulting from a rapid increase in a voltage
10 across said primary coil each of said plurality of times said coil switching device energizes said primary coil.

15. The system of claim 11 further including an ignition control circuit configured to control a coil switching device electrically connected to said primary coil, said ignition control circuit configured to control said coil switching device to energize said primary coil only a single time during any ignition plug firing event.

16. An ignition diagnostic system for an internal combustion
20 engine, comprising:

an ignition coil having a primary coil coupled to a secondary coil, said secondary coil connected across an electrode gap of an ignition plug;

means for producing a bias voltage across said electrode gap during a period of time following generation of a spark across said gap;

25 a detection circuit producing a buffered version of any ion current flowing across said electrode gap resulting from said bias voltage; and

a diagnostic circuit producing an output signal defining a pulse width indicative of a non-combustion event if said detection circuit fails to detect ion current flowing across said electrode gap resulting from said bias voltage.

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17. The system of claim 16 further including a capacitor electrically connected to said diagnostic circuit, said diagnostic circuit initially charging said capacitor to a pre-charge level and thereafter charging said capacitor proportional to an amount of ion current flowing across said electrode gap, said pulse width of said output signal defined by a discharge time of said capacitor from said pre-charge level to a predefined voltage level.

18. The system of claim 16 further including an ignition control circuit configured to control a coil switching device electrically connected to said primary coil, said ignition control circuit configured to control said coil switching device to energize said primary coil a plurality of times during any ignition plug firing event.

19. The system of claim 18 wherein said means for producing a bias voltage includes said coil switching device, said primary coil and said secondary coil, said bias voltage resulting from a rapid increase in a voltage across said primary coil each of said plurality of times said coil switching device energizes said primary coil.

20. The system of claim 16 further including an ignition control circuit configured to control a coil switching device electrically connected to said primary coil, said ignition control circuit configured to control said coil switching device to energize said primary coil only a single time during any ignition plug firing event.